1.4. LANDSCAPE CHANGES IN THE SZIGETKÖZ REGION, NW HUNGARY (PRELIMINARY RESULTS)

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1.4.1. INTRODUCTION

Covering almost 36.500 ha, the Szigetköz is the largest semi-natural flood area in the entire Danube Valley today. Its unique status explains the outstanding importance of its wetland habitats. Due to the region's particular geological, geomorphologic, climatic, and hydrological and soil properties, great habitat diversity has developed, which in turn supports a high biodiversity. This is reflected equally in the large variety of landscape mosaics, the plant communities, the high species diversity of communities and the unique species composition. The community spectrum reflects the almost natural state of the region, showing that it preserved its ecological potential until the 1990s (Kárpáti-Kárpáti, 1991; Simon et al., 1993). In addition to its important role in preserving biodiversity at several organisational levels, as a wetland biotope the Szigetköz has also the potential of buffering antropogenous loads, mostly that of nitrogen, phosphorous and toxic heavy metals.

The Szigetköz area has an exceptionally high ecological and landscape value even in European scale. Together with the Slovak Zitny Ostrov (Csallóköz), it has been a functioning, active floodplain containing a large area of islands, side arms, natural and planted forests, meadows and swamps, redbuds and arable land. In spite of previous human activities, all these landscape mosaics (and habitats) were still governed by the dominating dynamics arising from periodic and episodic floods with associated fluctuating levels of surface and groundwater. In particular, the active floodplain kept its dynamic character (Yon-Tendron, 1981).

Law protects sites of highest natural value since 1987 as a part of the Szigetköz Landscape Protection Area. The idea of establishing a joint Austrian-Hungarian-Slovakian National Park in the region has also turned up already.

1.4.2. THE MAIN GOAL OF THE STUDY

The alluvial territories have become as targets of scientific studies because of the following reasons:

changes in soil moisture regime could cause strong influences in landscape development and landscape maintenance

any modification in natural water regime would force the agricultural and forestry practice and the nutrient balance of the soil

wetlands are very sensitive for changing water regime of soils, as one of the most important ecological factor

As the major part of the Danube's water was diverted into the service canal in October 1992, the river's water level and the depth of ground water table in its environs dropped remarkably thereafter. Consequently, the Danube bed became exposed over large areas, while its tributaries and oxbow lakes dried up partly or completely. Changes of these environmental factors for the temporal and spatial transformation of natural vegetation types started to study in 1993. Because of the short term monitoring, our result can be seem as preliminary ones.

1.4.3. RESULTS

1.4.3.1. Natural site conditions and their changes

1.4.3.1.1. soils

Soils are a key element of the natural environment and are of fundamental importance to natural ecosystems and agriculture. The nature and fertility of the soil is dependent on many factors, but in the Szigetköz, the water regime of the surface layers is perhaps the most fundamental. The groundwater level plays an important role in this regime. Changes in groundwater level or character will impact on the soil and on all those elements dependent on it. The groundwater of the Szigetköz has a direct connection with the Danube. The Danube flows are the predominant source of groundwater recharge and control groundwater levels throughout the region.

The soils of the Szigetköz have developed from alluvial material under the influence of climate, vegetation and groundwater conditions (Várallyay, 1992). Groundwater levels thus determine long-term soil formation and also make an important contribution to the soil moisture regime and hence to the water balance of the area. This contribution depends critically on the depth of the water table with respect to the interface between fine-grained topsoil and the underlying gravel alluvium. Where the water, table is located within the topsoil, capillary effects supply the root zone from the groundwater for plant use. This subsurface input is essential to support current agricultural production and natural vegetation and also plays a key role in reducing vulnerability to drought. The seasonal responses of the Danube result in high flows (and hence high water table conditions) during the late spring and summer, when plant water requirements are the greatest. If the water table falls below this interface, this subsurface water supply is effectively lost. The nature and fertility of the soil is dependent on many factors, but in the Szigetköz, the water regime of the surface layers is perhaps the most fundamental. The groundwater level plays an important role in this regime. Changes in groundwater level or character will impact on the soil and on all those elements dependent on it. The groundwater of the Szigetköz has a direct connection with the Danube. The Danube flows are the predominant source of groundwater recharge and control groundwater levels throughout the region.

Apart from direct effects on soil water, the water table location is also critically important for soil chemistry, and thus to soil structure and fertility. The soils have a high natural calcium carbonate content, due to their alluvial origin. This is mobilised by plant activity and gradually leached to the base of the root zone: groundwater are also high in carbonates, and hence carbonate-rich water is drawn up by capillary action, as discussed above.

For the various impacts on the soil depending on their location in the Szigetköz will disturb the natural profile chemical equilibrium. A lowered water table will induce additional leaching; a higher water table, additional upwards transport. Increased evaporation (of pure water) from a near-surface water table will concentrate salts and carbonates in the upper part of the soil structure, with adverse effects on plant growth and soil structure.

Carbonate accumulation is of particular concern in those areas where the frequent fluctuation of water table levels would be expected due to peak power operation. If the water table lies close to the top-soil alluvium interface, the frequent upwards movement of carbonate-rich groundwater into the topsoil would be expected to cause carbonate precipitation to form an impervious hard pan.

1.4.3.1.2. Agriculture

Intensive agricultural production is carried out in the Szigetköz region. The crop yield of wheat, corn, sunflower, and alfalfa, major crops for Hungary is normally about 15-20% higher in the Kisalföld, including Szigetköz, than nationally, and often of higher quality. In the areas near the reservoir, where the groundwater level would have been extremely high, shallow rooting crops were to be grown because only the top layer of the soil would have been suitable. In the areas where the groundwater level would have decreased substantially, replacement, deeper rooting crops were to be grown. These would either have been extremely dependent on precipitation, in which case the security of yield would have significantly decreased on irrigation. Only 8-13% of the farmland in the Szigetköz is currently irrigated. Irrigation not only would be costly, but it has a range of potential disadvantages including adverse effects on soil structure.

1.4.3.1.3. Natural landscape and vegetation

From the beginning of this century the area of **forest stands** has continuously decreased on sites protected from floods, while those in the active floodplain have partly survived. In the 1960's, forests covered 9.000 ha in the Szigetköz. Within this, the proportion of poplar plantations has gradually increased and in the 1990's reached approximately 80% of the forested area. The remaining 20% occupied by semi-natural forests - *willow thickets, willow woods* and *poplar woods* are particularly attractive and species-rich. At some places (e.g. in the environs of the Middle-Szigetköz) stands have a definite pristine character with original forest biota and represent the highest natural value of the region and probably of the entire Danube Valley. Although weed species dominate in poplar plantations, some remnants of the original flora still occur. The bird and insect faunas are also rich in these plantations. The immense fall in the groundwater table can destroy these vegetation type and landscape within a few years.

Formerly *hardwood forests* (oak-ash-elm gallery forests) played important role on higher-lying flood areas. Only few fragments of these remained on the active floodplain, but several stands can be found in an almost natural state on the protected side of the Danube and along the Mosoni Danube. The species composition of these hardwood forests showed only 10% degradation since 1930.

On higher terrains *oak woods* and on several sand ridges *forest-steppe oak woods* grow as relicts of former warm climatic periods and contain several thermophilic drought-

resistant species. The expansion of these forests is expected in the future as a consequence of the groundwater table fall.

The mostly aquatic habitats of the Szigetköz support a diverse **wetland vegetation** and landscape. Numerous protected and relict species lived in these communities. *Aquatic pondweed communities, wet meadows and hayfields* are very various in this area. Traditional management practised throughout the past decades saved these wet meadows. The process of the habitat desiccation, the disappearance of the most susceptible relict or protected species, and the invasion of weeds have already started.

Only small fragments of the natural sand **dry grasslands** have survived the agriculture occupation in the Szigetköz. Thermophilic steppe species inhabiting these grasslands contribute to the high floristic diversity of this area.

The natural landscape types (characterized by their dominant vegetation types) were aggregated into six groups according to similarities in their ecological characteristics. The groups are as follows:

Distribution of natural habitats in the Szigetköz

Habitat and vegetation type	**Size of territory (ha)** (before 1992)
1.Flooded forests and aquatic-marsh herbaceous vegetation in the active floodplain	6.500
2. Oak-ash-elm gallery forests (hardwoods) in the active floodplain	200
3. Oak-ash-elm gallery forests (hardwoods) in the old floodplain	1.500
4. Aquatic habitats and wetlands in the active and old floodplain	2.800
5. Wet meadows and hayfields	2.600
6. Dry forests and grasslands	1.100
Summa	**14.700**

*Active floodplain – the section of the original inundated area. Floods, corresponding groundwater-table fluctuations are responsible for the existence of wetlands.

** Old floodplains (protected side of the floodplain) – it originate from natural floodplain but luck the determining factor. The influence of a fluctuating groundwater-table, which corresponds to the water level of the river, although reduced, is the only one remaining.

Beside the above-mentioned landscape elements, agricultural areas and settlements are characteristics as landscape units.

Szigetköz, till the 1990s was unique with respect to all ecological and nature conservation features. As a consequence of the diversion, the river water level as well as the ground water decreased, resulting the drying-out of the riverbanks side arms and oxbow lakes. Due to the past dramatic human impact, the replacement of floodplain vegetation and landscape mosaics by vegetation and landscape adapted to drier soils was an acceptable consequence of significantly lower water discharges in the Danube.

The expansion of weed communities due to the decreasing ground-water table still indicates the degradation of the natural value of the Szigetköz. An extensive weed invasion occurred in the exposed Danube bed, bans and oxbow lake bottoms (Simon-Szabó, 1995).

The substantial drop in the groundwater level will inevitably result in the death of these communities and the floodplain landscape. Most of wet meadows and hayfields have dried out or are currently drying out. Their transformation into arid, weedy grasslands has already started and their economic and biological value is negligible.

The colonization of the newly created biotopes started right after the river diversion. Rapidly invading weeds and seedlings of poplar and willow species were the first plants to become established here. Our studies in the area showed that secondary succession has started very quickly and soon has advanced to the stage of typical willow thickets, where various willow species dominate.

1.4.3.1.4. cultivated forest stands

The forest plays an important role in the ecosystem. In the Szigetköz, the alluvial forests, primarily poplars, are of great direct economic value, as compared with other indigenous species such as ash, elm, and oak. This area constitutes one of the most important raw material resources for cellulose production. Changes in the groundwater table and water regime negatively influence the growth and yield of these forests. Specifically, these changes would have threatened the softwood riparian forests of poplar and willow present in those areas. Although species requiring less water could have been planted, their biomass production and annual yields would have been much less than that of poplars. It has been suggested that new, slowly growing forests would not have been able to be harvested for 60-120 years.

1.4.4. Summary

The Szigetköz and its environs comprise the youngest, still developing part of the Danube's vast alluvial fan, where alluvial deposits are the exclusive sources of soil formation. In addition to the highly diverse geomorphology and soil properties, the regular yearly inundation is the most important ecological factor responsible for the development and long-term survival of the region's natural vegetation. Along with the frequency of floods and the depth of ground water table, other soil properties also play an important role.

In Hungary, the Szigetköz region is one of the most valuable territories from the point of view of landscape, nature conservation, as well as agriculture. Soils have a unique role in preserving the natural and semi-natural state of the landscape and they are very important determining factors of crop production. In this area, the particular groundwater conditions and associated soil moisture regimes have been a determining influence on soil and hence landscape development. In addition, the natural water regime, which provided a natural sub-irrigation for much of the area, was an essential factor in maintaining the natural ecosystems, as well as in enhancing agricultural productivity and reducing susceptibility to drought.

The rapid and substantial drop in the groundwater level was accompanied by a significant loss in soil moisture. The influence of it was very various from the natural landscape mosaics and the natural vegetation types point of view. Aquatic habitats, wetlands, wet meadows, hayfields and softwood forests in the lower floodplain has already started to drying out and as a consequence of it the degree of degradation of these vegetation types are rather high. The transformation of these valuable natural landscape mosaics into arid, weedy grasslands, forest stands or weed communities seem to be an irreversible process.

At the same time the expansion of dry forests and grasslands are expected in the near future as a consequence of the groundwater table fall.

1.4.5. REFERENCES

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